STATUS REVIEW OF DOE EVALUATION OF FISCHER-TROPSCH DIESEL FUEL AS A CANDIDATE ALTERNATIVE FUEL UNDER SECTION 301(2) OF THE ENERGY POLICY ACT OF 1992

DOE Contact: Linda Bluestein
Office Of FreedomCAR and Vehicle Technologies
For the Official Docket: EE-RM-02-200-C.3

STATUS REVIEW OF DOE EVALUATION OF FISCHER-TROPSCH DIESEL FUEL AS A CANDIDATE ALTERNATIVE FUEL UNDER SECTION 301(2) OF THE ENERGY POLICY ACT OF 1992

Abstract

The Department of Energy (DOE) has performed an extensive evaluation of Fischer-Tropsch diesel fuel (FTD) to determine whether FTD made from natural gas should be designated as an alternative fuel under section 301(2) of the Energy Policy Act of 1992 (EPAct). Such designation requires findings by DOE that a fuel is substantially not petroleum, offers substantial energy security benefits, and offers substantial environmental benefits.

Natural gas is not petroleum; therefore, DOE can make a straightforward finding that FTD made from natural gas is substantially not petroleum. The two “substantial benefits” criteria of section 301(2), on the other hand, are undefined. DOE’s evaluation of the benefits of FTD has, therefore, involved considerable interpretation of these terms as applied to FTD and DOE believes it has arrived at sound interpretations of the terms as applied to FTD. (See “Discussion of Issues Pertinent to Rulemaking to Designate Fischer-Tropsch Diesel as Alternative Fuel under section 301(2) of the Energy Policy Act of 1992,” referred to hereinafter as “Issues Paper,” DOE Docket No. EE-RM-02-200-C.3 and the further discussion below in this document.) Although there is considerable uncertainty about the energy security impacts of FTD, DOE found in its Issues Paper that the most likely impact would be some energy security benefit.

With regard to the environmental benefit criterion, evaluation is complicated because the potential impacts cover several different environmental factors including greenhouse gases and multiple different pollutants. FTD offers a combination of potential environmental benefits and potential detriments. Data are currently unavailable or inadequate on a number of environmental issues. DOE’s analysis shows that the most likely environmental impact from FTD production is an increase of uncertain but significant proportions in greenhouse gas (GHG) emissions. Therefore, DOE is unable, at this time, to make a finding that FTD offers substantial environmental benefits within the meaning of section 301(2). At the same time, DOE continues to believe that FTD is likely to reduce somewhat emissions of particulate matter (PM) and nitrous oxides (NO_x) in pre-MY 2007 engines, particularly in pre-MY 1998 engines. At this time, the existing data do not provide for reliable quantification of those emission reductions. DOE intends to leave the FTD docket open for further comment and evaluation as new data are submitted.

According to DOE's Office of Fossil Energy, there remains a potential for future engines to be developed so as to take advantage of the attributes of FTD in providing further reductions of criteria pollutants. Although data are presently lacking on this potential, DOE is funding research that could provide such data. The rulemaking docket will remain open and could provide a useful tool for public discussion of such data as it becomes available. It could also provide a venue for discussion of future life-cycle analyses and associated estimates of GHG impacts.

Executive Summary

After collecting and evaluating pertinent data and conducting a workshop, DOE is unable to make a finding at this time that FTD[1] yields "substantial environmental benefits" within the meaning of section 301(2) of EPAct. A finding that a candidate fuel offers "substantial environmental benefits" is a necessary finding to designate a fuel as an "alternative fuel" under section 301(2). DOE will keep its FTD rulemaking docket active so that stakeholders desiring to submit new data and information relevant to FTD may do so. DOE will evaluate the data periodically to make future decisions with regard to FTD designation as an "alternative fuel."

The basis for this conclusion can be summarized as follows:

- FTD appears to involve trading off criteria pollutant benefits that will actually diminish over time (due to changing vehicle technologies) against likely GHG increases (per unit of fuel used) that are likely to persist over time.
- Due to uncertainties about the production process parameters for FTD plants (where most of the relative increases in GHG emissions occur), which are still in a gestation stage, and wide scatter in existing data, it is impossible to quantify the potential particulate matter (PM) benefits/GHG detriments and to weigh them against each other.
- While potential limits on process GHGs equivalent to those from conventional diesel refining could be set as a specification of a section 301(2) designation, it does not appear that any existing or planned FTD plants would meet such a limit.
- The EPAct fleet alternative fuel vehicle (AFV) provisions are designed to catalyze future vehicle/fuel combinations by starting with a limited number of fleets nationwide. Because the criteria pollutant reductions of FTD, if used in EPAct fleets, would be neither widespread nor focused in pollutant-specific nonattainment areas, these fleets are not particularly suited to criteria pollutant abatement. The very limited value of these programs for criteria pollutant abatement does not justify subverting their intended role in catalyzing AFV programs for GHG reduction.
- It appears that the principal environmental benefit offered by FTD is reduction of PM emissions on existing vehicles but not on the future vehicles of primary importance to EPAct, which will have particulate aftertreatment systems. Differences between FTD and conventional diesel PM emissions with such systems are likely to be negligible. Directing FTD toward use in the new vehicles covered by EPAct would serve to minimize any emissions reductions the fuels might provide if used in the vehicle population at large.
- Because FTD would be used in conventional vehicles rather than AFVs, it would not serve for compliance with the EPAct AFV acquisition requirements, which the "alternative fuel" designations are primarily about. Designation of FTD would have little

[1] The rulemaking under consideration by DOE would have dealt only with FTD produced from natural gas. FTD from biomass and coal appear to be defined as "alternative fuels" by sec.301(2).

practical significance, while it could set adverse precedents in terms of the standards for designation. This would predicate DOE's evaluations on sets of hypothetical circumstances rather than straightforward scenarios.

- A number of additional data gaps also remain that are significant impediments to making a finding of "substantial environmental benefits." Among these are durability emissions data, materials compatibility data, and data on power loss resulting from FTD use. The power differential in particular suggests that existing criteria pollutant emissions data may have to be discounted. It could result in operators of older vehicles, those on which emissions benefits would otherwise be greatest, making engine adjustments to regain the lost power, which could negate some or all of the FTD emissions benefits.

Introduction

Diesel fuel made from natural gas through the process known as Fischer-Tropsch has been of interest to DOE.[2] Though the FTD itself would likely be imported, the sources of imports could be diverse, providing some energy security benefits. Many emissions tests on FTD have shown reduced emissions of PM and NO_x from existing diesel vehicles. DOE has provided grant funding for a number of research and development projects relating to FTD production and for FTD emissions testing.

DOE received three petitions requesting designation of FTD (or specific-company FTD fuels) as "alternative fuels" under EPAct. These petitions were submitted by Rentech, Inc., Mossgas Pty Ltd. (subsequently PetroSA), and Syntroleum Corporation. Section 301(2) of EPAct gives DOE authority to designate fuels as "alternative fuels" if three criteria are met: (1) the fuel is substantially not petroleum; (2) it yields substantial energy security benefits; and (3) it yields substantial environmental benefits.

While DOE began evaluating the petitions, Congress passed the Consolidated Appropriations Act of 2001 (Public Law 106-554, 1(a)(4)) containing the following provision:

> *Sec. 122. GAS TO LIQUIDS. Section 301(2) of the Energy Policy Act of 1992 (Public Law 102-486); 42 U.S.C. 13211(2)) is amended by inserting "including liquid fuels domestically produced from natural gas" after "natural gas."*

According to this provision, all liquid fuels, including FTD, produced domestically from natural gas would be classified as natural gas under section 301(2) of EPAct and treated as "alternative fuels." No commercial production of FTD exists in the U.S., and DOE does not believe that significant domestic production is likely in the future, while foreign production and possible U.S. imports are more likely. DOE decided to consider a rulemaking, although this provision complicated DOE's initial evaluations.

---

[2] For a brief description of Fischer-Tropsch process, see "Discussion of Issues Pertinent to Rulemaking to Designate Fischer-Tropsch Diesel Fuel as "Alternative Fuel" Under Sec. 301(2) of the Energy Policy Act of 1992," DOE Docket No. EE-RM-02-200-C.3, p. 4, the petitions submitted, and other submissions to the docket.

Background - EPAct Titles III and V

In the early 1990s, Congress enacted two distinctly different pieces of major legislation focusing on vehicle/fuel regulation: the Clean Air Act Amendments of 1990 (CAAA) and EPAct. The CAAA motor vehicle provisions focus on criteria pollutants while EPAct focuses primarily on petroleum replacement for energy security.

The CAAA authorities include both setting of national standards for vehicles and motor fuels and implementation of other programs targeted at areas that are failing to attain air quality standards for specific pollutants. The CAAA provides many measures for reducing criteria pollutant emissions from motor vehicles. Among the measures are strict tailpipe emissions standards for vehicles, controls on fuel properties and composition, and requirements that certain vehicle fleets operating in nonattainment areas use vehicle/fuel combinations even more stringent than the national standards (the Clean Fuel Fleet Vehicle or CFFV program). The Environmental Protection Agency (EPA) has adopted various tiers of such standards since 1992; enormous progress in reducing criteria pollutant emissions from vehicles have been achieved, and additional major progress is expected as new standards are phased in (through 2010) and older vehicles are replaced.

EPAct was adopted in 1992, two years after the CAAA, and had different foci. The provisions for alternative transportation fuels are found in Titles III - VI. The provisions most affected by the alternative fuel designations are those requirements relating to new AFV acquisitions (section 501, section 507, section 303) and related sections of Title III and Title V. The purpose of these requirements is primarily to promote a long term transition from petroleum fuels that will enhance U.S. energy security though improving the Nation's overall economy, reducing emissions of GHGs and enhancing the environment also were goals. Section 502(a) lays out the program goals for these titles: to "*ensure the availability of those replacement fuels that will have the greatest impact in **reducing oil imports, improving the health of our Nation's economy, and reducing greenhouse emissions***." (Emphasis added.)

In contrast to the major progress made in reducing criteria pollutant emissions since 1990 and the further progress expected in coming years, GHG emissions have continued to increase and are projected to continue doing so. Concerns about climate change also have increased since the passage of EPAct.[3]

Just as the goals of EPAct and the CAAA are very different, so too are the designs and scopes of the authorities provided within each to pursue those goals. Unlike the CAAA, EPAct does not provide authority to establish broad national standards for fuels or vehicles, nor does it provide tools for addressing specific criteria pollutants in areas that have failed to attain the standards for

[3] DOE, along with other Executive agencies, has undertaken a variety of activities to slow the growth of GHG emissions. An example is the "Climate VISION" initiative. See *EERE Network News*, February 19, 2003 and the accompanying DOE Press Release and "Statement by President Bush," www.eere.energy.gov/news/archive.cfm and http://www.whitehouse.gov/news/releases/2003/02/20030212.

those pollutants. Rather, it sets requirements for a limited number of centrally fueled fleets in major metropolitan areas, including attainment areas as well as nonattainment areas. EPAct is neither intended nor well suited to address criteria emissions from vehicles.

Congress singled out certain fleets to be subject to the EPAct provisions, in part to address the mutual dependency of alternative fuel infrastructure and AFVs. Because the alternative fuels believed by Congress to be potentially effective in pursuing the EPAct goals (listed in section 301(2)) require special vehicles and special refueling infrastructure, marketing of fuels and of vehicles were both believed stymied by each other's absence. Large, centrally-fueled fleets do not need widespread refueling infrastructure and can provide sufficient demand to induce manufacturers to offer light-duty AFVs. (See: Discussion of Issues Pertinent to Rulemaking to Designate Fischer-Tropsch Diesel Fuel as Alternative Fuel Under section 301(2) of the Energy Policy Act of 1992, DOE Docket no. EE–RM-02-200-C.3, ["Issues Paper," pp. 28-29.)

Section 301(2) includes a list of alternative fuels qualifying under EPAct. In addition to listing specific fuels, the section 301(2) definition also includes "*any other fuel the Secretary determines, by rule, is substantially notpetroleum and would yield substantial energy security benefits and substantial environmental benefits*." Thus, the statute contemplates that DOE may decide to designate additional alternative fuels. DOE, however, must make any such designations through a formal rulemaking process. Initiating a rulemaking would be premature if sufficient evidence is not available to allow DOE reasonably to conclude that the section 301(2) criteria are met. For example, if a fuel is still in development and adequate data are not available on production processes or vehicles, or if existing data are deficient, initiation of a rulemaking would be premature. While DOE may choose to undertake some level of its own research and data collection, the responsibility for proving the criteria ultimately falls upon the petitioners and other stakeholders urging DOE to make a designation.

Rulemaking Chronology and Issues

DOE reviewed the petitions received along with the limited data sets accompanying them to determine whether to proceed with a rulemaking. These data were supplemented by DOE, the National Renewable Energy Laboratory (NREL) and Argonne National Laboratory (ANL) with the much greater body of public domain data on FTD. DOE believes that the section 301(2) designation authority primarily was intended for designation of generic fuels rather than proprietary products or formulations. A generic approach to designation based on fuel and process specifications appeared the best way to proceed, particularly with regard to FTD, because of issues of efficiency and fairness as well as to ensure that the section 301(2) criteria would be met.

Another fact that emerged early-on in the evaluation process was that FTD does not fit into the EPAct fleet AFV programs. FTD is intended for use in conventional fuel vehicles while the EPAct programs require and give credits for acquisition of AFVs.[4] While FTD can be used in dual fuel

[4] See the FTD Issues Paper, section VI.

vehicles designed to run on both diesel fuel and an alternative fuel, such as compressed natural gas, operators of such vehicles would not be likely to use it. A designation of FTD could, therefore, be seen as largely "symbolic," as an FTD proponent pointed out[5]. DOE was not initially opposed to a symbolic designation. As will be discussed below, however, the symbolic nature of the designation ultimately makes both the necessary findings and the comparisons on which they would be based hypothetical. DOE now believes this calls into question the appropriateness of symbolic designations.

DOE made substantive evaluations of data to provide a basis for the FTD rulemaking, including an evaluation of criteria pollutant impacts by NREL and evaluation of GHG emissions and process efficiencies by ANL.[6] The FTD Issues Paper summarizes these two studies and evaluates a variety of additional pertinent issues. The completed studies were put in a docket (No. EE-RM-02-200, see www.eere.energy.gov/vehiclesandfuels/epact/petition/ftd_docket_index.shtml), and public comment on them was requested. A public workshop was announced in the *Federal Register* (67 FR 53747, September 10, 2002) and held on October 16, 2002, to provide additional opportunity for comment with presentations by DOE, NREL, ANL, and by FTD petitioners, and other stakeholders. DOE raised various questions and identified many gaps in the data pertinent to the rulemaking. Open discussion was encouraged, and a question/answer forum was held. The workshop was attended by twenty-nine individuals representing twenty-one different concerns apart from DOE staff and its consultants. Numerous additional parties submitted written comments to the docket.

Questions Reasonably Satisfied

Information provided at the workshop and in written submissions to the docket helped answer some of the questions and filled a few of the data gaps identified by DOE. DOE's understanding of the impacts of FTD, particularly the environmental impact, however, remains incomplete. Among the issues that have been addressed are the following:

Lubricity: Commentators noted that the American Society for Testing Materials (ASTM) is in the process of adding a lubricity specification to its D-975 diesel fuel specification. DOE was satisfied that there would be no need for an additional requirement for lubricity additives for FTD.

Cold Flow: Based on comments made at the workshop and comments submitted to the docket, DOE is persuaded that ASTM D-975 specifications - cloud point and cold flow pour points - would be sufficient to assure adequate cold flow properties of the FTD and that FTD can be produced to acceptable cold flow specifications either with or without additives.

Toxicity: DOE believes that emissions from FTD should be significantly less toxic than emissions from petroleum diesel fuel, at least in existing vehicles, as stated in the FTD Issues Paper. Since

---

[5] Comments of Stuart Bradford, Shell International Gas Ltd., workshop transcript p. 122.

[6] Docket No. EE-RM-02-200-C.2 (NREL) and C.1 (ANL).

that paper was drafted, additional data have been submitted to the docket, which supports this contention. DOE does not believe, therefore, that toxicity concerns should be an impediment to designation of FTD. Data are insufficient, however, for DOE to use toxicity as a basis for a finding that FTD offers “substantial environmental benefits.” It is not clear that the EPAct Title III and Title V programs would be suited to yielding “substantial environmental benefits” based on toxicity differences. Nor is it clear how significant differences in exhaust toxicity will be for vehicles meeting future emissions standards, particularly particulate standards.

A comparative study was submitted on emissions of the four “Toxic Air Contaminants” from diesel exhaust listed in the Clean Air Act (benzene, formaldehyde, acetaldehyde, and 1,3 butadiene) along with toxic polycyclic aromatic hydrocarbons both in the gas phase and bound in particulate matter. The study showed FTD to have among the lowest emissions of the test fuels for almost all of the toxic compounds analyzed and lower emissions than petroleum diesel for all of them. Most of the differences between FTD and petroleum diesel were statistically significant. Emissions of the other toxic compounds in diesel exhaust identified by EPA were not tested in that study[7]. Only a few speciated emissions tests have been submitted. No test studies exposing animals to FTD exhaust have been identified. Syntroleum did submit data from some studies in which mammals were given acute exposures to the FTD fuel itself - oral, skin and eye. These tests also indicated that the FTD test fuel itself is less toxic than petroleum diesel. No data have been identified on chronic exposures. No fuel composition data have been presented for the test fuels, which could be different from in-use FTD. Although EPA has identified alkanes in the diesel range as toxic (both in themselves and as precursors to aldehydes) due to respiratory tract irritation[8], the relative lack of aromatics suggests that FTD will be less toxic as a substance than petroleum diesel. What little data exist on exhaust species suggest that the same will be true of FTD exhaust.

Biodegradation: Additional laboratory test data have been submitted by Shell[9] and by Syntroleum on both neat FTD compared to petroleum diesel and on a group of blends of FTD with petroleum diesel. The data confirm DOE’s belief that FTD will be roughly comparable in biodegradation to petroleum diesel overall. For the most part, these tests show FTD to be more biodegradable than petroleum diesel in laboratory settings, though there were some anomalies within the results for some blends. As the FTD Issues Paper pointed out, FTD may actually be less biodegradable than petroleum diesel in actual leak situations, but the differences in either direction do not appear to be substantial.

---

[7] “Chemical Characterization of Toxicologically Relevant Compounds from Diesel Emissions,” Edwin A. Frame and Douglas M.. Yost, Southwest Research Institute, *Fuels for Advanced CIDI Engines and Fuel Cells, FY 2000 Progress Report*, DOE, pp. 73-80, attached to Syntroleum letter to docket dated October 10, 2002.

[8] *Health Assessment Document for Diesel Engine Emissions*, National Center for Environmental Assessment, Washington, D.C., May 2002, EPA/600/8-90/057F, p. 2-88, p. 9-2.

[9] Comments and data have been submitted by representatives of Shell Global Solutions, Shell International Gas, and Shell Gas and Power, all subsidiaries of Shell Oil Company acting in conjunction with one another. Such comments and data are referred to herein as being from “Shell.”

Ecotoxicity: Ecotoxicity data have been submitted by Syntroleum and by Shell. (None had been identified by DOE at the time the Issues Paper was drafted.) Tests were done on mysid shrimp, various freshwater fish, algae, and bacteria. All of these tests showed low toxicities for FTD by showing that only at high concentrations, if at all, were there significant mortalities. For the fin fish species, no mortalities were observed in either the Shell or Syntroleum tests at concentrations of 1000 mg/liter. For *a daphnia magna* (mysid shrimp), however, Shell showed no mortality at 1000 mg/liter, while Syntroleum showed total mortality at 16 milligrams (mg)/liter. The dose/response curve for the Syntroleum test was unusually steep (no mortality at 8 mg/liter, total mortality at 16 mg/liter). While the dose levels of FTD at which mortalities were shown was much higher than those expected for petroleum diesel, these discrepancies do raise questions about the validity of the data. Overall, available data indicate that FTD should have considerably lower ecotoxicity than petroleum diesel, consistent with expectations. While DOE believes that additional testing should be performed, ecotoxicity is not seen as an impediment to designation.

<u>Issues Substantially Unresolved</u>

A number of key questions and data gaps identified by DOE remain outstanding as summarized below.

Durability Data: No data involving mileage accumulation with FTD have been submitted. It was stated at the workshop that a mileage accumulation/durability emission testing program is in process but the data were not to become available until sometime in the future. NREL and the South Coast Air Quality Management District are conducting a mileage accumulation/operability study with a report also due in the future.

Materials Compatibility: Most FTD proponents at DOE's FTD workshop stated that the low aromatic content of neat FTD fuel would cause problems for nitrile elastomers but not for fluorocarbon elastomers used in new vehicles and new replacement parts today. Other information obtained by DOE, however, indicate ongoing concerns, and there is a notable lack of data confirming the acceptability of neat FTD. Proponents cited a memorandum by the California Department of Transportation (CalTrans) showing no problems observed when it used neat FTD. That memorandum has been submitted to the docket. It shows, however, limited usage of FTD. The CalTrans fleet used the FTD for only one month and only 7,500 gallons in 69 vehicles in different classes including Class 8 tractors. Thus, it appears that probably only 1-2 tankfuls of FTD were used in each vehicle. PetroSA stated at the workshop that it had in-house data indicating possible problems even with newer elastomers when exposed to zero-aromatic FTD but declined to provide the data. PetroSA favors use of 10 percent aromatics to avoid such problems. Shell, another of the few companies with actual market experience with FTD, submitted a 1999 Esslingen paper ("The Performance of Diesel Fuel Manufactured by the Shell Middle Distillate Synthesis Process," attachment to Shell docket comment F.6, shown as handout version of Ex#44C2A.pdf) and 2000 Diesel Engine Emissions Reduction (DEER) Conference paper (attachment to comment F.6, DEER 2000v4.pdf) that note concerns over materials compatibility. They recommend addition of antioxidant to prevent peroxide formation and recommend use of FTD blends rather than neat FTD to avoid elastomer problems. An email from Shell also says that Shell has "in-house work on an elastomer which allows us to take appropriate action when introducing the fuel. Unfortunately, at this stage we cannot release the data." DOE is not in a position to recommend or require such action without knowing what remedies Shell refers to or having reviewed its data. And it is questionable whether DOE should be designating a fuel that risks causing such problems, since public refueling stations could dispense the fuel into vehicles whose operators would be unaware of the need for such special action. Thus, there are inadequate data to assure that materials compatibility will not be a problem, and these concerns suggest that a more appropriate use of FTD would be as a diesel component rather than as a neat alternative fuel for EPAct programs.

Fuel Economy: The NREL docket study referred to a test program that showed greater per-Btu (British thermal units) fuel economy for FTD than petroleum diesel. The FTD Issues Paper translated this greater vehicle efficiency into greater well-to-wheel (WTW) efficiency, but DOE asked for data confirming and explaining this greater efficiency. The reasons for this observed phenomenon remain unclear and lead DOE to question whether efficiency and GHG estimates should be based on it.

A number of additional studies submitted to the docket have similarly shown or claimed higher engine efficiency but with results and explanations that sometimes conflict. Various papers submitted by Shell have attributed the greater efficiency to higher specific calorific value. A Society of Automotive Engineers (SAE) paper refers to greater thermal efficiency in passenger cars but says the effect is not clear in heavy-duty vehicles ("Consideration for Fischer-Tropsch Derived Liquid Fuels as a Fuel Injection Emission Control Parameter," *SAE Technical Paper Series*, no. 982489, October 1998). It says the efficiency improvement is greater at lower engine speeds and may be the result of an earlier start of combustion due to higher cetane, suggesting that the effect may not be found with post-1998 engines, which are largely insensitive to cetane (see below). Another paper given at the International Symposium on Automotive Technology and Automation using simulated FTD found better efficiency at intermediate speeds but lower efficiency at rated speeds. The coefficients of the fuel consumption differentials were also varied in the different studies. Moreover, as addressed below, there is reason to believe that the FTD testing was done at less than equivalent power to the petroleum diesel control fuels; in particular, the FTD test fuels never reached the peak power of the petroleum diesel. Possibly part or all of the observed fuel consumption difference may have simply reflected this power difference. Therefore, it is not clear whether the well-to-wheel energy efficiencies and greenhouse gas estimates should be adjusted to credit greater vehicle efficiency, as was done in the FTD Issues Paper.

Power Loss: Vehicles tested to date operating on FTD apparently experience a power loss of approximately 10 percent compared to petroleum diesel. Shell's Esslingen papers from both 1999 and 2001 point this out, with the 2001 paper noting that the existing emissions test data may be "misleading" due to the power differential. Shell's DEER 2000 paper also notes a 10 percent power loss, saying that it can be partially overcome by pump tuning. SAE Paper 982489 shows torque 5-9 percent lower with FTD than with petroleum diesel. This power differential is of concern for a number of reasons. As Shell pointed out, operators of older vehicles (the vehicles that would otherwise show the greatest emission benefits) may try to neutralize the power loss by making engine adjustments which may negate most or all of the emissions benefits or even over compensate to the point of causing emission increases. Operators may resort to more powerful and higher-emitting vehicles for certain tasks, or even purchase such vehicles for full-time use, reversing any emissions benefits that might have been realized by using FTD. It is not clear that EPAct intended or that Federal policy generally should try to effect emissions reductions by lowering available power. Moreover, as Shell suggests, the existing emissions data may overstate the emissions benefits of FTD. One study of power control during heavy-duty dynamometer testing, for example, showed considerable error in equalizing power through throttle adjustments during test cycles.[10] Moreover, the peak power conditions, where the emission rates are typically at their highest, will not be equivalent. A test driver simply not pushing the vehicle operating on petroleum diesel beyond the 90 percent power level reached with the FTD might also achieve significant emissions reductions. While DOE does not believe that the power differential accounts for the major part of the emissions reductions shown in the FTD data, DOE does not know how to accurately discount the data.

Fuel Specifications for FTD Designation: FTD proponents made diverse proposals for fuel specifications for an FTD designation. Such specifications would be the means of ensuring that the section 301(2) criteria are met. One proponent proposed maximum sulfur content of 1 part per million (ppm), maximum aromatics of 500 ppm, and maximum oxygen of 100 ppm, while rejecting any limit on GHG emissions. These extremely strict fuel specifications would have to be applied at the plant gate, since contamination in the distribution system would likely cause the fuel to exceed these limits, raising questions about their meaningfulness. Two proponents proposed a minimum cetane number of 70 though fuel parameter studies show the oxides of nitrogen benefit from higher cetane diminishing from around 53 and being negligible beyond 60,[11] while various studies also show particulate matter increases associated with a cetane increase, particularly above 50.[12] All of the FTD proponents argued against any process specification to limit GHGs. Proponents appeared to see the specifications DOE might set under section 301(2) as serving as a *de facto* standard for FTD generally and argue that DOE should not set specifications that would interfere with the emerging FTD industry. Since the EPAct designation would be largely symbolic, and since apparently no other standards exist or are being established for FTD, DOE believes that there is merit to the suggestion that its designation could be looked to as a general FTD standard. That has not been DOE's intent, nor does DOE have any intention of constricting the emergence of FTD with a rulemaking. An EPAct designation, however, must specifically assure that the section 301(2) criteria are met. Designation under section 301(2) is an inappropriate vehicle for setting general FTD standards due to the limited scope of EPAct programs and the specific statutory

---

[10] "Speed and Power Regressions for Quality Control of Heavy Duty Vehicle Chassis Dynamometer Research," David L. McKain and Nigel N. Clark, *SAE Technical Paper Series*, No. 1999-01-0614.

[11] SAE Paper 982489, *supra.*, p. 4; CONCAWE Report, p. 14, citing EPEFE report; "The Effect of Cetane Number Increase Due to Additives on NOx Emissions from Heavy-Duty Engines," Draft Technical Report, EPA420-S-02-012, June 2002, p. 13.

[12] SAE Paper 982489, *supra.*, p. 4; CONCAWE Report, p. 19, citing EPEFE report; "Fischer-Tropsch Fuels Impact on a Diesel Engine Performance," ISATA Paper 00ELE009, p. 5; "JCAP Combustion Analysis Working Group Report," Part I, *SAE Technical Paper Series*, No. 2002-01-2824, p. 13; *Ibid.* Part II, SAE no. 2002-01-2825, pp. 14-15; "EPA HDEWG Program-Engine Test Results," by T.W. Ryan, et. al. Southwest Research Institute, R.A. Sobotowski, et. al., Cummins Engine Company, G.W. Passavant, EPA and T.J. Bond, Amoco. (Some studies show differing results but the majority seem to support the positive relation between CN and PM emissions.)

criteria.

Evaluation of Environmental Impacts: Greenhouse Gases vs. Criteria Pollutants

As discussed above, EPAct Title V makes clear that the "environmental benefits" goal of the EPAct AFV programs includes reducing GHGs. DOE believes that environmental benefits under section 301(2) could include contributions from other media such as criteria pollutant reductions. Still, GHG emissions are an important component of DOE's consideration in deciding whether to designate a new alternative fuel.

Expected FTD Use vs. Hypothetical EPAct Fleet Use: In estimating FTD impacts on both GHG and criteria pollutant emissions, DOE faces a variety of methodological problems deriving from:

- uncertainty over operating parameters from future FTD plants since they are expected to differ significantly from existing plants;

- questions of what vehicles should be used as the basis for testing and estimating FTD tailpipe emissions; and

- data problems, including lack of data on various types of vehicles, wide scatter in the existing data base, uncertainty of the validity of key data, and imperfect understanding of the relationships between fuel parameters and emissions.

DOE believes that the most likely actual future for Fischer-Tropsch (F-T) application, which could be enhanced with a symbolic EPAct designation, will be F-T production abroad, for use in Europe and parts of Asia (where diesel use is growing dramatically). It is not likely to be the use of neat FTD fuel designed to meet ASTM D-975, as was the basis for most of the existing test data, nor blending of such FTD with an existing diesel fuel. Rather, F-T is likely to be used to produce a blendstock for blending with other distillate blendstocks to create a tailored final fuel. Use in those European and Asian markets entails considerable use in light-duty diesel vehicles which are largely absent from the U.S. market at present. In fact, most of the vehicle emissions data presented were from European light-duty diesel automobiles not available in the U.S. (Numerous studies of diesel fuel parameter effects have found different relationships by vehicle technology, and the FTD data also show considerable variation, though no vehicle classification scheme suggests itself.) A GHG life-cycle analysis (LCA) submitted in summary form by Shell suggests that the entire fuel cycle modeled is external to the U.S. DOE does not believe it is appropriate to make an EPAct designation based on data and analysis of neat FTD when the principal impact of the designation will be to foster a different type of production and use. Nor is an EPAct designation appropriate for a product not likely to be either produced or used in the U.S. Moreover, any criteria pollutant benefits resulting from the FTD use will accrue in areas outside the U.S.

Looking at FTD in terms of its hypothetical use in EPAct fleets is also problematic. The EPAct fleet programs are principally requirements for acquisition of new AFVs. Only one test program has been identified in which FTD was used in AFVs - 2 heavy-duty vehicles were converted to dual fuel (Compressed Natural Gas/FTD). Moreover, the great majority of the test data relate to vehicle model years prior to 1998; since that time engine technologies have changed in sensitivity to fuel parameters, particularly to cetane. Because the EPAct programs apply only to new vehicle acquisitions, this data would be largely irrelevant to a rulemaking for fuel to actually be used in EPAct fleets.

DOE believes that little to no FTD would be available for use in EPAct fleets, even if it were to qualify as an "alternative fuel", for a number of years. Heavy-duty vehicles will incorporate catalytic particulate traps (CPTs) to meet 2007 emissions standards and NO_x aftertreatment devices (probably NO_x adsorbers) to meet 2010 standards. Light-duty vehicles will also have to meet much stricter emissions standards (Tier 2) starting in 2005. Thus, no actual FTD emissions data exist on the production vehicles of future model years, when FTD would have penetrated the EPAct fleet market. There are a number of engineering principles, as well as some test data on vehicles retrofitted with CPTs, that suggest FTD criteria pollutant benefits will be negligible with those future vehicles.

The EPAct fleet program requirements are only for light-duty vehicles, though additional credits can be earned for heavy-duty AFVs once EPAct requirements are met. In the U.S., more than 95 percent of diesel use is in heavy-duty vehicles, and only one light-duty diesel vehicle model is currently available. There is some expectation that additional light-duty diesel vehicles will be introduced in coming years. These, however, would be built to meet the Tier 2 standards on petroleum diesel. As noted above, none of these have been tested, and there is reason to expect that even light-duty vehicles built to meet the stricter emissions standards will have smaller or possibly negligible emissions reductions with FTD.

To the extent that FTD does not fit into the EPAct fleet programs, evaluation of its relative benefits and detriments is greatly complicated and problematic. The likely actual use of F-T for diesel blendstocks presents a different set of benefits and problems than would its hypothetical use in EPAct fleets if it were used as a neat fuel in AFVs. Meaningful comparisons are virtually impossible and do not lend themselves to the types of findings required for legitimate rulemaking.

Greenhouse Gas Emissions: ANL had prepared a background paper on GHG emissions from FTD compared to other diesel fuels, including ultra-low sulfur diesel (ULSD), which was cited and discussed in the FTD Issues Paper and at the DOE FTD workshop, where a presentation on the results of the analysis was given. Using its GREET model (which has more than 800 registered users representing governmental agencies, industries, research institutions, universities, etc. worldwide), ANL estimated well-to-wheel GHG increases from FTD in stand-alone plants to be 6-18 percent greater than for ULSD, with a middle value of 12 percent. In the FTD Issues Paper, DOE discounted these increases to reflect a possible 4 percent per-Btu fuel economy increase for FTD and showed a final 2-13 percent increase on a WTW basis. As discussed above, although a number of additional studies also show a fuel economy advantage for FTD, the observed differentials are not consistent, and no satisfactory explanation has been provided of the mechanism responsible for the FTD advantage. A power loss of possibly as much as 10 percent has been noted for FTD so that the fuel economy differential may simply reflect less power output over the test cycle. It could even suggest a fuel-economy deficit for FTD at equivalent power.

FTD plants that export electricity also are estimated to have 0-13 percent higher WTW GHGs than ULSD with a mean of 7 percent higher. Only plants that export steam will have a possible benefit - a range from a 16 percent benefit to a 3 percent increase. Based on plants announced to date, however, it appears that not more than a small percent of FTD plants would export steam, and a substantial majority of plants will probably export neither steam nor electricity.

While under the most favorable assumptions FTD could have equivalent or even lower GHG emissions than petroleum diesel, generally-accepted regulatory practice dictates that regulatory decisions are based on the most conservative assumptions. While DOE's FTD Issues Paper allowed some favorable assumptions to arrive at GHG increases of 2-13 percent for FTD, a more truly conservative comparison would be between ANL's P90 (90 percent probability) estimate for FTD and its P10 estimate for ULSD, which would result in a 26 percent increase for FTD. Moreover, when it was suggested at the workshop that DOE might set a GHG or process energy limit somewhere beyond the existing estimates for FTD GHGs, FTD proponents objected, pointing out that the industry is still in its infancy and that DOE should not constrain it.[13] Thus, there appears to be a reasonable chance that GHGs from future FTD technologies will be significantly greater than the estimates ANL made based on the process data provided. This also suggests that the ANL P90/P90 estimate of a 18 percent increase may not be conservative enough and that the FTD P90 vs. petroleum diesel P10 differential of 26 percent may be a more appropriate regulatory assumption.[14]

PriceWaterhouseCoopers (PWC) has prepared, on behalf of Shell, an alternative LCA to the GREET model but has not submitted the analysis to the docket for public consideration. Summary versions of the LCA and its results were submitted to the docket by Shell within its Esslingen 2003 paper and within the Shell publication "Gas to Liquids: Shell Middle Distillate Synthesis and the Environment." The information provided in these summaries is too incomplete to conduct a thorough comparative analysis. Based on these summaries, however, DOE disagrees with the PWC LCA and believes that the GREET model and the estimates derived from it are more meaningful and representative. The PWC model assumes two separate "systems" - a refinery system and an "FTD system." It postulates substitution interactions between the two that are favorable to FTD but which seem unrealistic. It assumes a fixed level of residual oil with refineries vs. a lack of residual oil with FTD, resulting in changes to fuel use in the electric power industry in Asia. In reality, the refinery sector has considerable flexibility to reduce residual production (or reduce light distillate production) in favor of diesel or to increase residual production. Shortages of residual oil for electric power would raise the value of residual, to which the refinery sector would respond with additional production. By looking at FTD and petroleum diesel as separate "systems," with fixed product output ratios, the Shell LCA also appears to attribute to FTD GHG reductions for other products, which would result from a separate set of decisions by other sectors. It may also give

[13] See for example the comments of Steve Colville of Chevron-Sasol Corporation and Steve Woodward of Syntroleum Corporation, Transcript from DOE Public Workshop, pp. 179-181.

[14] This differential and proposed allowance for unrestricted increases contrasts with the commitment of the American Petroleum Institute to increase the energy efficiency of refinery operations by 10% over the next ten years in conjunction with DOE's "Climate VISION" initiative. See footnote 3, *supra.* for citation.

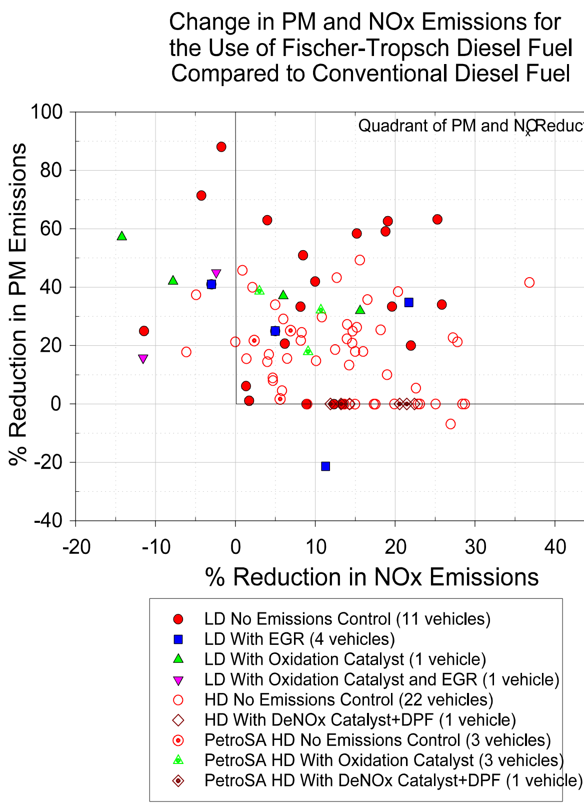
FTD considerable credit for displacing water desalinization, which would be likely only at FTD plants in the Middle East, reliance on which could be detrimental rather than beneficial to energy security. Even with all these questionable credits for FTD, Shell shows FTD causing GHG increases of 5 percent over petroleum diesel if coal rather than natural gas is used in the Asian power sector, as seems likely according to recent analysis.

FTD proponents mainly argued that, in light of the uncertainties associated with GHG estimates, DOE should essentially ignore potential GHG increases, while designating FTD based on its criteria pollutant benefits. As indicated above, DOE believes that neither EPAct nor rulemaking procedures generally, which involve burdens of proof to make a designation, allows it to adopt this approach. Comments from the U.S. Army Tank-Automotive Command (TACOM)/National Automotive Center suggested a GHG limit equivalent to GHGs from petroleum derived diesel fuel. The National Biodiesel Board (NBB) argued that because GHG reduction is the principal environmental benefit "discussed under the EPAct program," environmental benefits of FTD "should be evaluated solely in light of the GHG emissions of FTD." NBB further argued that FTD would fail such an evaluation of environmental benefits and, therefore, should not be designated. DOE does not agree with NBB that GHG benefits are the sole environmental benefit that may be considered in designations under section 301(2). It does agree with TACOM, to the extent that TACOM recognizes that GHG emissions are an important component of DOE's consideration.

Criteria Pollutant Benefits: While DOE believes that there will be criteria pollutant benefits from use of FTD, at least in light-duty vehicles built prior to model year 2005 and medium/heavy-duty vehicles prior to model year 2007, existing data are inadequate to accurately quantify the emission reductions. Quantification of emission benefits is important for two reasons: (1) section 301(2) requires a finding that environmental benefits be "*substantial*;" and (2) if DOE were to determine that a designation could be made based on criteria pollutant benefits outweighing other environmental impacts, quantitative estimates of the criteria pollutant reductions would be necessary.

The majority of test data on FTD emissions are on pre-model year 1998 vehicles. Much of the data is on light-duty vehicles, though very few light-duty diesel vehicles are in use in the U.S. A number of tests have also been run on post-98 vehicles. Though the results of this testing are mixed, there are a number of reasons to believe the emissions reductions will continue but will be smaller with post-98 vehicles, particularly the NO_x reductions. EPAct, however, is truly a forward-looking statute, concerned primarily with future vehicle/fuel combinations. If FTD were actually used in EPAct fleet programs (which is unlikely since there are almost no AFVs that it could be used in), only new vehicle acquisitions would count, so it would really be future model year vehicles that would be relevant. (Moreover, significant volumes of FTD would probably not be available for EPAct use for a number of years in any event.) Vehicle emissions technology will be changing substantially for light-duty vehicles in 2005 and for heavy-duty vehicles between 2007-2010. Prototype vehicles meeting future emissions standards are not available at this time for testing of FTD, so no really applicable data exist. There are, however, reasons to believe that PM and NO_x emissions differences between FTD and petroleum ULSD in such vehicles will be negligible.

The majority of existing data on criteria pollutant emissions with FTD show reduction of both PM and NO_x. There is considerable scatter to the data, however. At least 10-11 data points actually show NO_x increases with FTD, while another approximately 17 data points show NO_x reductions of less than 5 percent While only two data points show PM increases, a considerable number show negligible PM reductions. (See figure below for data on FTD vs. 300 ppm sulfur diesel fuel.)



The reasons for the scatter are not completely understood, but it is believed that differences in vehicle technology are a partial cause.

Unlike the CAAA programs, EPAct fleet programs are neither intended nor well suited to criteria pollution abatement, particularly in light of the inconsistent emissions impacts of FTD. EPAct fleet programs represent a fairly small number of vehicle fleets operating in many metropolitan areas of the U.S., some of which are in nonattainment of the NO_x standard, some in nonattainment of the PM standard and some in attainment of both standards. If FTD were used in these fleets, there would be at least a reasonable prospect that the EPAct-covered fleet vehicles in a particular NO_x nonattainment area, for example, would show no NO_x benefits with FTD. Similarly, there might be little or no PM benefits in some fleets in PM nonattainment areas. And GHG increases would likely be associated with the FTD production for use in all of these areas, including those in attainment of both NO_x and PM standards. The very limited value of these programs for criteria pollutant abatement does not justify subverting their intended role in catalyzing AFV programs for GHG reduction.

In its original background paper on criteria pollutant emissions, NREL was able to obtain statistical significance only for an estimate of 6-20 percent NO_x reductions based not on FTD emissions data but on fuel parameter data. This reduction was estimated based on 2-5 percent reductions for each increase of ten cetane numbers, with an additional 5 percent reduction from reduction in aromatic content. Additional literature on fuel property effects, however, suggests strongly that the effect of cetane on NO_x emissions diminishes somewhere around 53 and becomes negligible by around cetane 60 (see fn 8. *supra.)*. Based on this, it appears that the upper end of the NO_x reduction range originally estimated by NREL is not valid and that a better estimate would be around 6-12 percent even for older engines (as described in the FTD Issues Paper, EPA estimated up to 6 percent reduction). As NREL pointed out, however, an abundance of data also show engine changes implemented in the model year 94-98 period making NO_x emissions relatively insensitive to cetane number, so that NO_x reductions will probably be not more than 5-8 percent or so on average for vehicles produced after 1998. A number of studies also show that for pre-98 engines, fuel changes affect emissions both by chemical changes and by physical changes to engine operating parameters while for post-98 engines, only chemical changes are observed. The existing FTD data do not reflect a statistically significant difference in emissions between these model year groups (though it does show non-significant indications of such a difference). The lack of significance could be due to the wide scatter, lack of comparability between tests, insufficient quantity of data within engine classes, rounding, or other data deficiencies. It does not negate the reasons for believing that the newer engines will have less emissions reductions from FTD. In addition, EPA has released data showing a strong inverse linear relationship between base NO_x levels and NO_x reductions from Lubrizol's PuriNO_x additive, which achieves emissions reductions by reducing combustion temperature, the primary way that FTD is believed to reduce NO_x in post-98 engines. Thus, as engine technologies succeed in reducing NO_x emissions from petroleum diesel, additional reductions from FTD can be expected to dwindle not only absolutely but even in percentage terms.

No data exist on emissions from FTD in vehicles equipped with NO_x adsorbers, which are the leading NO_x emission control devices expected to be used to meet post-2010 heavy-duty emission standards and may also be used in light-duty vehicles meeting Tier 2 light-duty standards after ULSD becomes widely available in the U.S. It is considered somewhat likely that such systems will involve fuel sensors and model-based computerized combustion control. If this is the case, NO_x emissions in such engines would probably be close to equivalent whether FTD or petroleum ULSD is used. Even if such combustion control is not utilized, NO_x emissions meeting such standards are likely to be so low that differences between FTD and petroleum ULSD would be negligible. FTD might prove advantageous to such systems due to its lower sulfur content than ULSD and its lower engine-out emissions, which might reduce need for desulfation and adsorber regeneration. Since FTD would account for only a small percentage of the market, however, such systems could not be designed to take advantage of its properties. This advantage does not appear to be a "substantial environmental benefit" within the meaning of section 301(2), particularly in light of the likely GHG increases.

For PM emissions, the same distinction between pre-98 and post-98 vehicles (without CPTs) is not apparent in the FTD emissions data. Rather, the post-98 PM emissions differences between FTD and petroleum diesel show an even greater scatter than the pre-98 data, ranging from a PM increase of 20 percent to a PM decrease of 90 percent. This greater scatter can be explained partly by the lower emissions levels of the later model year vehicles such that even small absolute differences in emissions show up as large percentage differences. Despite the greater scatter, the data for both pre-98 and post-98 engines without CPTs show a concentration in the range of 15-30 percent PM reductions for FTD, with an even greater proportion of the data in the 15-40 percent range. Although the higher cetane of the FTD apparently would be associated with higher PM, other fuel parameters more than make up for that. Fuel parameter studies are somewhat contradictory on the precise parameter or parameters most important in this regard, but the benefits can clearly be attributed to a group of related and largely collinear parameters: higher hydrogen/carbon ratio, lower total aromatics and polyaromatics, lower density, and lower T90/T95 points (T = distillation temperature). The higher hydrogen/carbon ratio is the parameter with the highest correlation to the reduced emissions. Thus, it appears that setting a hyrogen/carbon and/or other parameter limit for FTD, which would be met largely by the lower aromatic content, would assure that it would yield significant PM reductions in engines without CPTs.

NREL has performed a number of emission tests on engines, both light-duty and heavy-duty, retrofitted with CPTs. These engine/CPT combinations differ from expected future CPT systems in that the devices are not integrated back into the engine control system. These CPTs are designed to operate on 30 ppm sulfur fuel rather than 15 ppm sulfur fuel. These tests uniformly showed PM emissions below detection limits with both the FTD and the petroleum ULSD; thus, no discernible differences between the fuels were observed. It can be expected that future integrated CPT systems, like NO_x adsorbers, will use fuel sensors and closely controlled combustion so that engine-out PM emissions will be coordinated with the chosen CPT technology. This is likely to result in overall differences between FTD and 15 ppm sulfur fuel being even more insignificant. As with the NO_x adsorbers, FTD may have some advantages in terms of regeneration and desulfation frequency and efficiency. While FTD could offer potential for cost savings if future engines were designed for it rather than for petroleum ULSD, such a scenario is highly unlikely since FTD will not be the dominant diesel fuel. The regeneration benefit from FTD in engine systems designed for petroleum ULSD will not amount to a “substantial environmental benefit” within the meaning of section 301(2).

As suggested above, both the NO_x and PM emission reduction data (and estimates shown above) on existing vehicles may need to be discounted to compensate for power loss observed with the FTD fuel, though it is not known by how much. With the future vehicles expected to have comparable emissions using Fischer-Tropsch diesel or ultra-low sulfur diesel, the power loss could actually result in substitutions that increase emissions with FTD overall, though emissions generally will be much lower so that any such increases should also be insignificant.

Domestic vs. Foreign FTD as EPAct Fuel

The Consolidated Appropriations Act, 2001 (Public Law 106-554, 1(a)(4)) amended EPAct to define the term “*natural gas*” so as to include *“liquid fuels domestically produced from natural gas,"* thus designating all domestically produced gas-to liquid (GTL) fuels as EPAct “alternative fuels.” Some FTD proponents have argued that DOE’s consideration of substantial environmental benefits be based on equivalence of foreign FTD to domestic FTD, some even suggesting that domestic FTD has been found to yield substantial environmental benefits. DOE has rejected that approach. DOE has made no finding that domestic GTL yields substantial environmental benefits. On the contrary, in the FTD Issues Paper, DOE raised concerns that certain GTL fuels (glyme and diglyme) could be more toxic than petroleum diesel fuel. The legislative process that created the statutory section 301(2) list of alternative fuels is fundamentally different from the rulemaking process prescribed for DOE to make designations based on specific criteria and findings; there is no legal requirement that the fuels designated by Congress meet the same criteria that fuels designated by DOE must meet. Moreover, Congress could easily have designated all FTD in that provision; instead it explicitly limited the designation to domestic GTL.

Conclusions

DOE is unable to make a preliminary finding that FTD meets the section 301(2) "substantial environmental benefit" criterion, and, therefore, DOE will not initiate a rulemaking proceeding to designate FTD as an EPAct "alternative fuel." FTD appears likely to involve trading off criteria pollutant benefits that will diminish over time against GHG increases that will persist with expected technology evolution. Production and use of FTD are likely to increase GHG emissions. It appears that the principal environmental benefit offered by FTD is of PM reduction on existing vehicles but these benefits are less likely on the future vehicles that are of primary importance to EPAct. These future vehicles would be the only vehicles affected if FTD actually fit into the EPAct fleet programs. FTD, however, does not fit into those programs. The EPAct fleet AFV provisions, designed to catalyze alternative fuel vehicle and alternative fuel marketing by starting with a limited number of fleets nationwide, are not suited to criteria pollutant abatement either nationally or in pollutant-specific nonattainment areas. Due to uncertainties about the production process parameters for FTD plants, which are still in a gestation stage, and unavailability of pertinent data, data uncertainty, and wide scatter in existing data, it is difficult to quantify the PM benefits/GHG detriments and to weigh them against each other. With the future vehicles of most importance to EPAct, the criteria pollutant benefits are likely to be insignificant, while GHG emissions increases are likely to persist.

According to DOE's Office of Fossil Energy, there remains a potential for future engines to be developed so as to take advantage of the attributes of FTD in providing further reductions of criteria pollutants. Data are presently lacking on this potential, however. While DOE is funding research that could provide such data, the rulemaking docket will remain open and could provide a useful tool for public discussion of such data as it becomes available. It could also provide a venue for discussion of future life-cycle analyses and associated estimates of GHG impacts.

DOE has also previously found only a modest energy security benefit as described in DOE's earlier Issue Paper in the docket. Therefore, designation of FTD as an "alternative fuel" also appears problematic because FTD does not clearly provide "substantial energy security benefits."

In addition, under the existing statute, EPAct fleet compliance is primarily through acquisition of AFVs, not through alternative fuel use (though AFVs acquired by alternative fuel providers must operate on alternative fuels except when operating in areas where the appropriate fuel is unavailable). FTD, which is used in conventional diesel vehicles, does not provide a means of compliance. Its designation as an “alternative fuel” would provide little practical benefit to FTD producers.

DOE will keep its FTD rulemaking docket active so that stakeholders desiring to submit new data and information relevant to FTD may do so. DOE will evaluate the data periodically to make future decisions with regard to FTD.

ACRONYMS	DEFINITIONS
AFV	Alternative fuel vehicle
ANL	Argonne National Laboratory
ASTM	American Society for Testing Materials
Btu	British thermal units
CFFV	Clean Fuel Fleet Vehicle program
CPT	catalytic particulate trap
CAAA	Clean Air Act Amendments of 1990
DEER	Diesel Engine Emissions Reduction Conference
DOE	Department of Energy
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 1992
F-T	Fischer Tropsch
FTD	Fischer-Tropsch diesel fuel
GHG	greenhouse gas
GTL	gas-to-liquid
LCA	life-cycle analysis
LEV	low emission vehicles
mg	milligram
NBB	National Biodiesel Board
NO_x	oxides of nitrogen
NREL	National Renewable Energy Laboratory
P	probability
PM	particulate matter
ppm	parts per million
PWC	Price Waterhouse Coopers
RFG	reformulated gasoline
SAE	Society of Automotive Engineers
T	distillation temperature
TACOM	U.S. Army Tank-Automotive Command
ULSD	ultra-low sulfur diesel
WTW	well-to-wheel